Adaptation of Biology Attitude Questionnaire to Turkish

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Abstract
The aim of this study was to adapt 'Biology Attitude Questionnaire' which was developed by Prokop. 242 high school students from Ankara, Turkey participated in the study. Exploratory and confirmatory factor analysis were performed in order to determine the structural validity of the six dimensional scale. As a result, the final structure of the scale was found to be consisting of three factors and 22 items. The Alpha coefficients of the three factors were found to be 0.882 for the first factor- importance of biology, 0.854 for the second factor- progress of biology lessons and 0.828 for the third factor- interest toward biology.

Introduction
The importance of biology has increased undeniably in the 21st century. This elevation in the importance has caused the researchers in education to focus on biology teaching (Gül & Yeşilyurt, 2010). In contrary, biology lessons are defined as a difficult by students despite its relation to daily life (Staeck, 1995). Some students find biology lessons boring if it is taught mostly by lecture (Leonard, 2009). Learning environments, which are managed by teachers who fail to use innovative teaching techniques and instructional practices which are described by constructivist approaches, cause low levels of poor understanding and academic achievement (Rabgay, 2018).

Biology is a unique discipline in which students can find opportunity to carry out investigations both in the laboratory and in the field. However, increasing use of virtual environments, internet instead of hands-on investigations in biology has been increasing (Prokop, P., Prokop, M. and Tunnicliffe, 2007) There is another incontestable argument that in some countries and schools, science teaching is underfunded which in turn makes it harder for the teachers and instructor to find equipment and to employ technicians (Tranter, 2004).

Attitude is accepted as an important descriptor of behavior with its cognitive and affective dimensions. Some attitudes are of great importance in having success in some activities such as field trips, lab activities. Also it can be hypothethized that students' attitude toward science and biology has an important role in reaching success in these lessons (Hamurcu, 2002). Positive attitude toward science and biology can provide students with better understanding and learning the topics and activities (Doğru & Kıyıcı, 2005).

There are several scales that measure students' attitude toward biology (Wang, Wu & Huang, 2007; Yılmaz, 2012) in Turkish, most of which consider the attitude toward biology as unidimensional (Atıcı & Atıcı, 2012; Kara & Yeşilyurt, 2007). When examined, it can be seen that biology courses has many factors that affect or shape the students' attitude toward biology. Therefore there is a need to use a multidimensional scale. The aim of this study is to satisfy this need in literature by adapting students' attitude toward biology scale developed by Prokop (Prokop, Tuncer and Chuda, 2007) to Turkish. Also there is a need to measure the attitude of students not only in the way of teaching the lessons but also in the way they see the biology course as an opportunity to have a job related to biology in the future.

Method

Data collection
The Biology Attitude Questionnaire (BAQ) (Prokop, Tuncer & Chuda, 2007) contains 24 items in its final form divided into six dimensions as follows: interest, career, importance, teacher, difficulty, and equipment. It is a five-point Likert scale; ranging from "strongly disagree" to "strongly agree" with "neither disagree nor agree" as the pivotal point of the scale. The scale was first conducted as a cross-age study applied to students who are at grades $5-9$. At the end of application to Slovakian students, Cronbach's alpha values were calculated for each dimension, they were between 0.69 and 0.36. Although results can be considered as appropriate, dimensions with relatively low reliabilities, "equipment" (0.36), "difficulty" (0.46), have been further examined to avoid misinterpretation of the results. Cronbach's alpha for "interest" ($\alpha = 0.68$), "career" ($\alpha = 0.62$), "importance" ($\alpha = 0.69$) and "teacher" ($\alpha = 0.62$) showed satisfactory reliability.

Application Method

The first step of the adaptation was to get permission from the author - developer (Pavol Prokop) of the scale via email. The original language of the scale is English. The scale was firstly translated to Turkish by two experts who are English teachers and have a master's degree in English literature and then translated back to English by another two experts with the same qualifications. The consistency between the Turkish and English forms were examined. The Turkish version of the 24 item-scale was then examined by Turkish Literature experts for the language validity and some editions were made for easy and complete understanding. The final draft was checked by the two experts from biology education for the conceptual validity.

Before the application of the scale, positive items were scored from 1 to 5, from "strongly disagree" to "strongly agree," respectively, while negative items were scored in the reverse order.

Regardless of their genders, the questionnaire was applied to 242 11th grade students from a private high school in Ankara, Turkey, in 2019 spring semester. The group was chosen from the 11 graders, because this age is thought to be closer to complete the biology curriculum than 9th and 10th grade students and attended almost all of the laboratory works during high school. 12th graders were not included in the research that they have some concerns such as getting prepared for the university entrance exam. So they were suspected to participate in the application without reluctance and the answers would not be reliable.

Analysis and Findings

Exploratory (EFA) and confirmatory factor analysis (CFA) were conducted over the data obtained from 242 participants.

It is observed that the six dimensional structure of the scale was not between the acceptable range according to the consistency indices and it does not yield valid results. On the other hand, for a valid factor structure, exploratory factor analysis (EFA) was conducted on the scale items. As a result of EFA, it is seen that the 24 item scale is obviously composed of 3 factors as shown on the eigenvalue graph in **Figure 1**.

Confirmatory factor analysis (CFA) was conducted in order to determine the structural validity of the six dimensional 'attitude toward biology scale". According to CFA results, *t* values of all 24 items were found significant. The factor load values (Lambda) of the scale were shown in **Figure 2**.

Consistency indices are used to determine if the observed data shows consistency with the model. The consistency indices for the 24 item model which was developed to measure the attitude toward biology were shown on the **Table 1**. These indices are goodness of fit index (GFI), comparative fit index (CFI), normed fit index (NFI), non-normed fit index (NNFI), relative fit index (RFI), standardized root mean square residual (S-RMR), root mean square error of approximation (RMSEA).
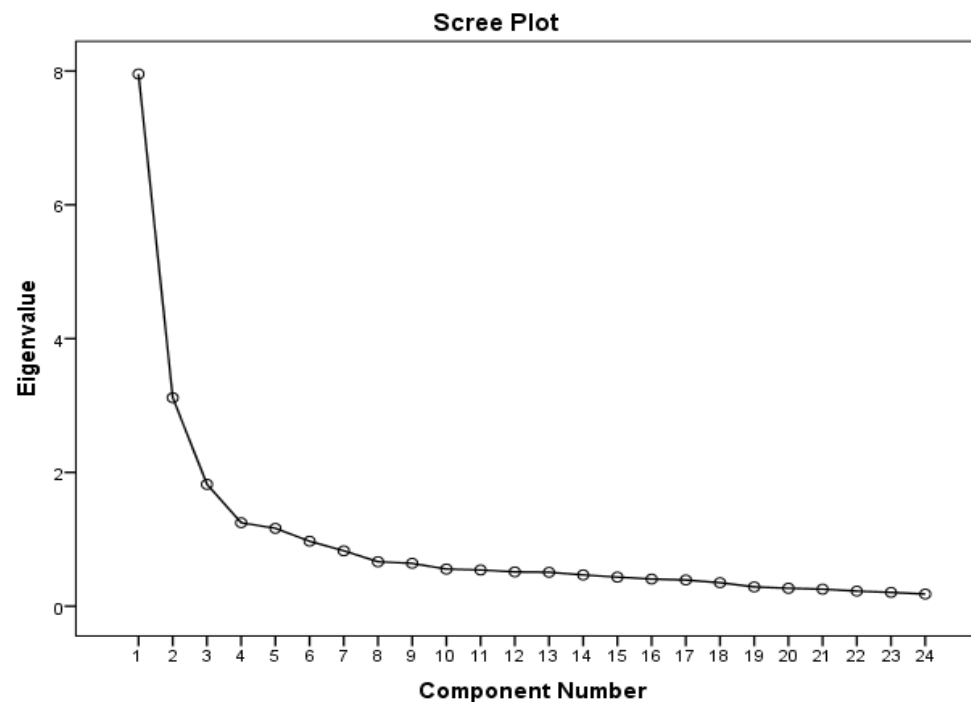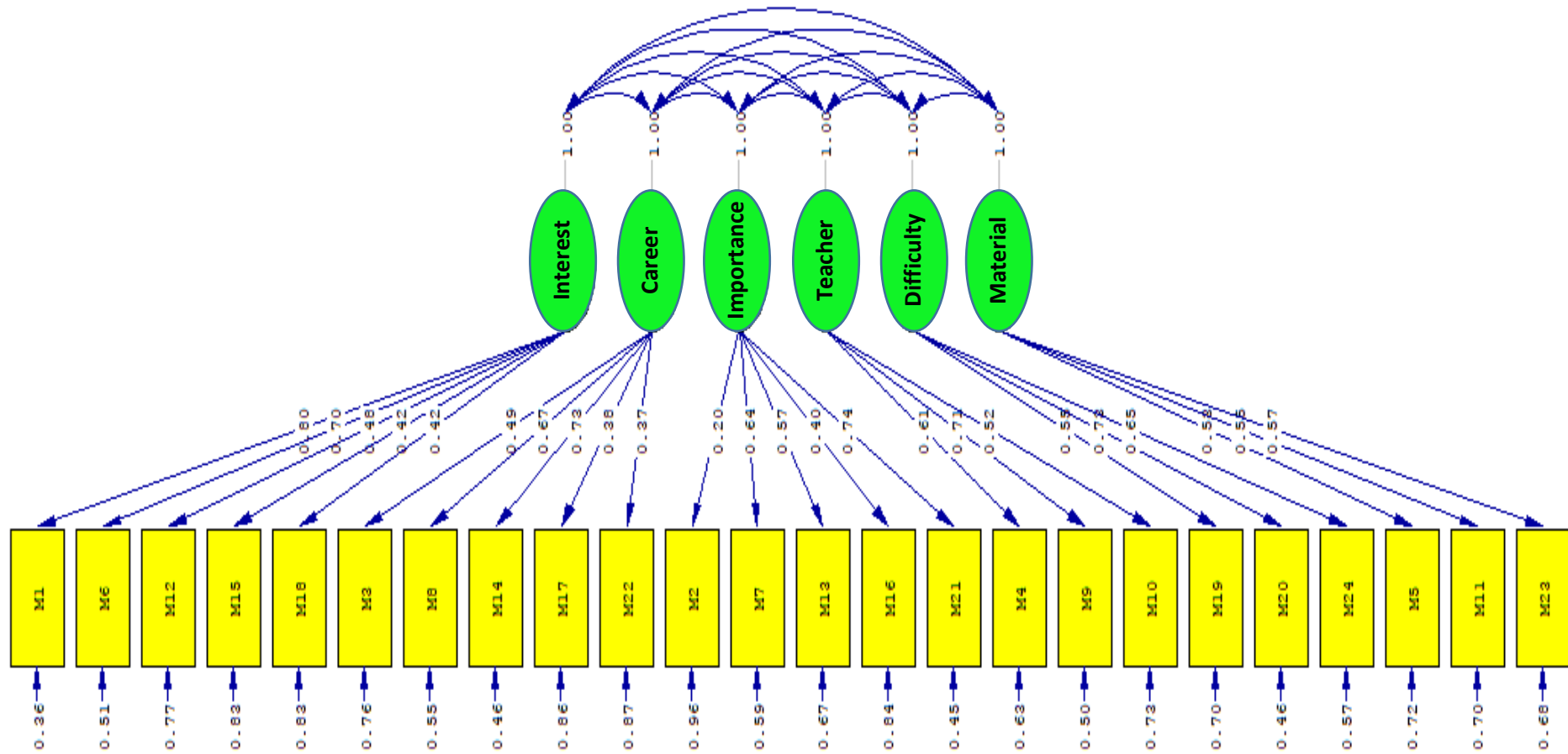

Figure 1. Line graph of eigenvalues of the 24 items

Table 1. Consistency indices of scale items for the factor structure

Consistency Index	Acceptable Range	Value
X^2/sd	<5 Medium consistant <3 Well consistant	1341.88/237 = 5.66
GFI	>0.90	0.64
CFI	>0.90	0.86
NFI	>0.90	0.83
NNFI	>0.90	0.84
RFI	>0.85	0.80
S-RMR	< 0.08	0.12
RMSEA	< 0.08	0.139

Figure 2. The factor load values (Lambda) of the scale

Chi-square=1341.88, df=237, P-value=0.00000, RMSEA=0.139

Result and Conclusion

Factor load values of the scale, which was limited to three factors, were examined as EFA was applied over the data. Items 10 and 17 were excluded from the scale as the difference between their factor loads for two factors were found to be smaller than 0.10. EFA was accordingly applied again to the remaining 22 items. The variance of the measured structure of the three factor-structure was found to be 55%. In the first factor, there found to be 10 items and the eigenvalue of the factor was found as 7.437. In the second factor, there are 7 items and the eigenvalue of the factor was found as 2.948. Finally, in the third factor, there are 5 items and the eigenvalue of the factor was found as 1.648.

Table 2 shows the distribution of items into factors, factor loads of the items in these factors together with the item total correlations found in the reliability analysis and Alpha coefficients.

Table 2. Distribution of items into factors. Factor loads of the items in these factors together with the item total correlations and Alpha coefficients.

Factor	Item no	Factor load	Item total correlation	Alpha coefficient
Factor 1	M12	.747	.716	
	M13	.708	.682	
	M2	.697	.618	
	M22	.684	.567	
	M20	.666	.677	0.882
	M8	.659	.601	
	M1	.659	.588	
	M21	.592	.540	
	M18	.564	.493	
	M3	.548	.644	
Factor 2	M9	.818	.728	
	M4	.781	.671	
	M5	.773	.651	
	M24	.749	.660	0.854
	M14	.740	.671	
	M23	.636	.568	
	M11	.539	.418	
Factor 3	M6	.738	.551	
	M7	.721	.654	
	M15	.714	.747	0.828
	M16	.690	.650	
	M19	.654	.537	

There were 24 items in the original questionnaire. Reliabilities of factors defined by the Alpha internal consistency are found to be high. Item total correlations are found to be higher than 0.30. Indicated in the **Appendix A** as the questionnaire was converted to 22 items with 3 factors. The contents of the items were not changed. But the titles of the factors were named according to the items that they contain. The items were firstly grouped based on the original questionnaire, then factors were named consistently with their original names. For example, factor 1 is named as *importance of biology and future carrier relation*; factor 2 as *progress of the biology lessons* and factor 3 as *interest toward biology and learning curiosity* consistently with the total correlations and contents of the items in each factor. Alpha coefficients for the 3 factors are found to be 0.882, 0.854, and 0.828 respectively.

There are different scales that can measure student attitude towards biology. Kara & Yeşilyurt. (2007) applied the Attitude towards Biology Scale which was developed by Geban et al. (1994) on 9th grade students to investigate the differences between the one of the commercially widespread found on the market educational software that was used in experimental group and traditional teaching method that was used in control group on the cell division topic through students' achievements. Changes in the existing misconceptions and attitudes towards biology and the alpha coefficient of the scale was found to be 0.851.

In another study Kışoğlu (2018) applied biology science and course attitude scale consisting of three sub-dimensions (interest, pleasure, and anxiety) on high school students to examine motivation of science high school students towards learning biology and their attitude towards biology lessons. The scale was developed by Atik et al. (2015) and the Alpha coefficient was found to be 0.911 for *interest* sub-dimension, 0.897 for the *pleasure* sub-dimension, and 0.866 for the *anxiety* sub-dimension.

The English version of the scale consists of 6 factors which are interest toward biology, future career in biology, importance of biology, biology teacher, difficulty and equipment. On the other hand, the scale which was obtained at the end of adaptation was found to be consisting of 3 factors which are identified as *importance of biology* (contains items from factors interest toward biology, future career in biology, importance of biology and difficulty of the original version), *progress of biology lessons* (contains items from factors future career in biology, biology teacher, difficulty and equipment of the original version), and *interest toward biology* (contains items from factors interest toward biology, importance of biology, and difficulty of the original version). The scale used in this study aims to measure the attitude of students toward biology by means of different dimensions.

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APPENDIX A. Biology Attitude Questionnaire (BAQ) (The Adapted Turkish Version)

Item No	Biyolojinin Önemi ve Gelecek Kariyer İlişkisi	①	②	③	④	⑤
12	Daha fazla biyoloji dersi almak isterim.					
13	Diğer dersleri ve olguları anlamam için biyoloji bilgisi gereklidir.					
2	Biyoloji dersi kavramsal becerilerimi geliştirmeye yardımcı olur.					
22	Bir biyolog olmak isterim.					
20	Biyoloji dersi benim için en kolay derslerden biridir.					
8	Biyoloji bilgisi gelecekteki kariyerim için önemlidir.					
1	Biyoloji dersini diğer derslerden daha çok severim.					
21	Biyolojideki gelişmeler yaşam kalitemizi artırır.					
18	Biyoloji dersinde canlı organizmalarla çalışmak ilgi çekicidir.					
3	Doğa ile ilgili belgeselleri izlemeyi severim bu yüzden bu alanda kariyer yapmak isterim.					
	Biyoloji Dersinin İşlenişi					
9	Biyoloji öğretmenim aktif bir şekilde çalışmamızı sağlar.					
4	Biyoloji öğretmenimi severim.					
5	Biyoloji öğretmenim her uygulamalı çalışmada resim çizer veya görsel kullanır.					
24	Okulumuzda biyoloji dersinin öğretilme şeklini beğeniyorum.					
14	Biyoloji öğretmenim benim rol modelimdir. Onun gibi çalışmak isterim.					
23	Biyoloji dersi için hazırlık yaparken daha önce biyoloji derslerinde kullandığımız malzemeler aklıma gelir.					
11	Biyoloji ekipmanı asla kullanmayız.					
	Biyolojiye Yönelik İlgi ve Öğrenme Merakı					
6	Doğa ve biyoloji benim için yabancıdır.					
7	Diğer derslere göre biyoloji dersi benim için önemli değildir.					
15	Biyoloji dersinden çok hoşlanmam.					
16	Hiç kimsenin biyoloji bilgisine ihtiyacı yoktur.					
19	Biyoloji dersinde öğretilen konuları anlamakta sık sık zorlanırım.					

1: Kesinlikle katılıyorum **2:** Katılıyorum **3:** Kararsızım **4:** Katılmıyorum **5:** Kesinlikle katılmıyorum